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Title:

EXTRUSION BLOW MOLDED REUSABLE STORAGE CONTAINERS WITH VARYING WALL THICKNESS

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EXTRUSION BLOW MOLDED REUSABLE STORAGE CONTAINERS WITH VARYING WALL THICKNESS

Cross-Reference to Related Application

This application claims the benefit under 35 U.S.C. § 119(e) of U.S. provisional patent application serial no. 60/430,403 filed December 3, 2002, the disclosure of which is incorporated herein by reference.

Technical Field

Improved polymeric reusable storage containers are disclosed. More specifically, improved reusable storage containers are disclosed manufactured using a extrusion blow molding process. Still more specifically, improved reusable storage containers are disclosed with varying wall thicknesses so that key structural areas of the container have a greater wall thickness than other less important structural areas of the container. Still more specifically, the wall thickness of the container can vary both axially along a wall and radially across a wall through use of the disclosed manufacturing process and die apparatus.

Background of the Related Art

Reusable storage containers are known. Such reusable storage containers can be fabricated using an extrusion blow molding process or an injection molding process. Figs. 1 and 2 illustrate a container 10 that can be fabricated using a conventional extrusion blow molding process. Further, Figs. 3 and 4 illustrate a container 20 that can be manufactured using a conventional injection molding process. Like reference numerals will be used to refer to like or similar structural parts for the containers 10 and 20 and these reference numerals will be used to describe the novel containers and manufacturing processes of the present invention in the following sections of this specification.

The containers include a bottom panel 21 which is connected to and disposed between two opposing corner sections 22, only one of which can be seen in Figs. 1 and 3, and two opposing bottom end corner sections 23. Each bottom side corner section 22 connects the bottom panel 21 to one of two opposing side panels 24. Each bottom end corner section 23 connects the bottom panel 21 to one of two opposing end panels 25. Further, each side panel 24 is disposed between and connected to the opposing end panels 25 by one of four vertical corner sections 26 to form an open box structure as shown in Figs. 2 and 4 with a continuous upper rim 27. Further, each

vertical corner section 26 is connected to a bottom end corner section 23 and a bottom side corner section 22 by a bottom corner junction 28 (see Figs. 1 and 3).

Further each container 10, 20 includes a similar top or lid 31. Each lid 31 includes a top panel 32 disposed between and connected to opposing top side corner sections, one of which is shown at 33 in Fig. 3, and two opposing top end corner sections 34. Each top side corner section 33 connects the top panel to one of two opposing top side panels 35 (see Figs. 2-4). Each top end corner section 34 connects the top panel 32 to one of two opposing top end panels 36. Each top side panel 35 is disposed between and connected to the top end panels 36 by one of four top vertical corner sections 37 (see Fig. 3) to form a continuous rim 38 for engaging the upper rim 27 of the container portion 41. Each top vertical corner section 37 is connected to a top side corner section 33 and a top end corner section 34 by a top corner junction 39 (see Fig. 3). The end panels 25 of the container portion 41 may also include handles 42.

As seen in the cross-sectional views provided in Figs. 2 and 4, the wall thicknesses of the various components, *i.e.*, the end panels 25, bottom panel 21, bottom end corner sections 23, etc., are uniform in thickness. This uniformity in thickness is required for injection molded containers, like the container 20, as constant wall thickness is required to minimize adverse flow characteristics within the mold filling stage, such as incomplete filling of the mold and trapped air in the mold, both of which can result in damaged or unusable final products. Further, for extrusion blow molded products, like the container 10, a constant wall thickness is also required due to the static nature of the die through which the parison is extruded.

However, it would be desirable to produce reusable storage containers, having similar structural features as the containers 10 and 20 illustrated in Figs. 1-4 but with a varying wall thickness. Specifically, it would be desirable to have a greater wall thickness at key structural areas of the containers 10 and 20, such as the vertical corner sections 26 and a thinner wall thickness in less important structural areas such as central areas of the end panels 25 and side panels 24. Similarly, with respect to the lid 31, it would be useful to be able to manufacture a lid 31 having a thinner top panel 32 and thicker top vertical corner section 37. Such containers 10, 20 and lids 31 with varying thicknesses would provide two benefits. First, structural integrity of the containers 10, 20 and lids 31 would be assured while reducing the overall weight of

the containers 10, 20 and lids 31. Further, material savings could be achieved thereby reducing the overall cost of the resultant products.

SUMMARY OF THE DISCLOSURE

An improved "right-weighted" storage container is disclosed which comprises a container portion comprising a bottom panel connected to and disposed between two opposing bottom side corner sections and two opposing bottom end corner sections. Each bottom side corner section connects the bottom panel to one of two opposing side panels. Each bottom end corner section connects the bottom panel to one of two opposing end panels. Each side panel is disposed between and connected to the end panels by one of four vertical corner sections to form an open top box structure with an interior cargo space and a continuous upper rim. The four vertical corner sections have an average thickness greater than an average thickness of at least one of the end panels or the side panels.

In a refinement, the four vertical corner sections have an average thickness greater than an average thickness of the side panels and an average thickness of the end panels.

In a refinement, the average thickness of the four vertical corner sections is greater than an average thickness of the bottom panel.

In a refinement, an average thickness of the four vertical corner sections is less than an average thickness of four bottom corner junctions where each vertical corner sections meets one of the bottom end corner sections and one of the bottom side corner sections.

In a refinement, the container portion is formed by a co-extrusion blow molding process.

In a refinement, each of the end panels further comprises a handle, each handle having an average thickness greater than the average thickness of at least one of the end or side panels.

In a refinement, each of the end panels further comprises a handle, each handle having an average thickness greater than the average thickness of the end panels and the side panels.

In a refinement, the container further comprises a lid. The lid comprises a top panel disposed between and connected to two opposing top side corner sections and two opposing top end corner sections. Each top side corner section connects the top

panel to one of two opposing top side panels. Each top end corner section connects the top panel to one of two opposing top end panels. Each top side panel is disposed between and connected to the top end panels by one of four top vertical corner sections to form a continuous rim for engaging the upper rim of the container portion. The four vertical top corner sections have an average thickness greater than an average thickness of at least one of the top end panels or top side panels.

In a refinement, the four vertical top corner sections have an average thickness greater than an average thickness both the top end panels and top side panels.

In a refinement, the average thickness of the four top vertical corner sections is greater than an average thickness of the top panel.

In a refinement, an average thickness of the four top vertical corner sections is less than an average thickness of four top corner junctions where each top vertical corner sections meets one of the top end corner sections and one of the top side corner sections.

In a refinement, the lid is formed by a co-extrusion blow molding process.

A method manufacturing a three dimensional reusable storage container is disclosed. The method comprises:

providing a parison of polymeric material;

providing a mold comprising a cavity defining a container portion comprising a bottom panel connected to and disposed between two opposing bottom side corner sections and two opposing bottom end corner sections, each bottom side corner section connecting the bottom panel to one of two opposing side panels, each bottom end corner section connecting the bottom panel to one of two opposing end panels, each side panel being disposed between and connected to the end panels by one of four vertical corner sections to form an open top box structure with an interior cargo space and a continuous upper rim;

providing an adjustable annular die comprising an outer peripheral surface and an inner peripheral surface with a gap disposed therebetween for extruding the parison, the gap being non-uniform in radial width between the inner and outer peripheral surfaces, the gap also defining an annular cross sectional area, the annular cross sectional area being expandable and contractible by moving the outer peripheral surface closer to the inner peripheral surface or vice versa,

opening the mold; and

extruding the parison through the die while moving the outer peripheral surface of the die closer to the inner peripheral surface of the die or vice versa so that a plurality of cross sections of the parison have a non-uniform thickness and further so that the thickness of the parison is non-uniform along an extruded length of the parison;

closing the mold;

inflating the parison against the cavity of the mold so that the four vertical corner sections have an average thickness greater than an average thickness of at least one of the end panels or side panels.

In a refinement, the inflating of the parison against the cavity of the mold results in the four vertical corner sections having an average thickness greater than an average thickness of the end panels and greater than an average thickness of the side panels.

In a refinement, the inflating of the parison further results in the average thickness of the four vertical corner sections being greater than an average thickness of the bottom panel.

In a refinement, the inflating of the parison further results in an average thickness of the four vertical corner sections being less than an average thickness of four bottom corner junctions where each vertical corner sections meets one of the bottom end corner sections and one of the bottom side corner sections.

In a refinement, the mold cavity further defines handles disposed on each of the end panels, and wherein the inflating of the parison further results in each handle having an average thickness greater than the average thickness of the end and side panels.

In a refinement, the mold cavity further defines a lid, the lid comprising a top panel disposed between and connected to two opposing top side corner sections and two opposing top end corner sections, each top side corner section connecting the top panel to one of two opposing top side panels, each top end corner section connecting the top panel to one of two opposing top end panels, each top side panel being disposed between and connected to the top end panels by one of four top vertical corner sections to form a continuous rim for engaging the upper rim of the container portion,

wherein the inflating of the parison further results in the four vertical top corner sections having an average thickness greater than an average thickness of at least one of the top end panels or top side panels.

In a refinement, the inflating of the parison further results in the four vertical top corner sections having an average thickness greater than an average thickness of the top end panels and greater than an average thickness of the top side panels.

In a refinement, the inflating of the parison further results in the average thickness of the four top vertical corner sections being greater than an average thickness of the top panel.

In a refinement, the inflating of the parison further results in an average thickness of the four top vertical corner sections being less than an average thickness of four top corner junctions where each top vertical corner sections meets one of the top end corner sections and one of the top side corner sections.

A adjustable die for extruding a parison is disclosed. The die comprises an outer peripheral surface and an inner peripheral surface with a gap disposed therebetween for extruding the parison, the gap being non-uniform in radial width between the inner and outer peripheral surfaces, the gap also defining an annular cross sectional area, the annular cross sectional area being expandable and contractible by moving the outer peripheral surface closer to the inner peripheral surface or vice versa.

In a refinement, the outer peripheral surface of the die is expandable and contractible.

In a refinement, the container and/or lid are manufactured from polyethylene, such as high density polyethylene. Other suitable materials for the above-referenced container and lid and manufacturing methods will be apparent to those skilled in the art.

In a further refinement, the lid may be manufactured and provided separately. Accordingly, the above-disclosed manufacturing method and adjustable die may be applied to the separate manufacture of a lid.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed storage container, lid, manufacturing methods and adjustable die are described more or less diagrammatically in the accompanying drawings wherein:

Fig. 1 is a perspective view of a reusable storage container that can be manufactured using prior art methods as well as the manufacturing methods disclosed herein;

Fig. 2 is a sectional view of the container shown in Fig. 1 and further illustrating a lid;

Fig. 3 is a perspective view of a reusable storage container including a lid that may be manufactured using prior art methods as well as the manufacturing methods disclosed herein;

Fig. 4 is a sectional view of the container and lid illustrated in Fig. 3;

Fig. 5 is a sectional view of a mold cavity and die used to extrusion blow mold improved reusable storage containers and lids as disclosed herein;

Fig. 6 illustrates, schematically, the opening of the mold and the extrusion of the parison during the extrusion blow molding process disclosed herein;

Fig. 7 illustrates the mold, parison and die illustrated in Fig. 6 and further illustrates the pinching of a bottom portion of the parison with pinch plates;

Fig. 8 illustrates the mold, parison, die and pinch plates of Fig. 7 but with the mold closed just prior to the inflation of the parison;

Fig. 9 is a perspective, sectional and schematic view of the closed mold and parison after inflation of the parison against the mold cavity;

Fig. 10 is a schematic illustration of a shaped die for use in the manufacturing processes disclosed herein;

Fig. 10A is a partial sectional view of the shaped die shown schematically in Fig. 10;

Fig. 11 is a graphical representation of three shaped dies used in the manufacturing processes disclosed herein;

Fig. 12 is a schematic illustration of a parison extruded through the shaped die of Fig. 10;

Fig. 13 is a schematic illustration of the parison of Fig. 12 that has been extruded and inflated against a mold cavity;

Fig. 14 illustrates, graphically, variation in thickness of a parison along an axial length of the parison used in the manufacturing methods disclosed herein;

Fig. 15 is a schematic illustration of a parison with varying thickness along the axial length thereof;

Fig. 16 illustrates, schematically, the parison of Fig. 15 after inflation against a mold cavity; and

Fig. 17 is a schematic illustration of a parison that has been extruded through an adjustable shaped die, similar to the one shown in Fig. 10 but which has been adjusted during the extrusion of the die to vary the annular gap between the inner and outer die plates to vary the thickness of the parison both radially and along the axial length of the parison.

It should be understood that the drawings are not necessarily to scale and that the embodiments are illustrated by graphic symbols, phantom lines, diagrammatic representations and fragmentary views. In certain instances, details which are not necessary for an understanding of the disclosed containers, lids, manufacturing methods and adjustable dies and other details difficult to perceive may have been omitted. It should be understood, of course, that this disclosure is not necessarily limited to the particular embodiments illustrated herein.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Improved methods for manufacturing storage containers like those shown at 10 and 20 and lids like that shown at 31 in Figs. 1-4 will be described in detail below. To decrease the weight of the containers 10, 20 and lids 31 without sacrificing structural integrity, the above containers 10, 20 and lids 31 are manufactured so that an average wall thickness at the vertical corner sections 26 is greater than an average wall thickness at the side panels 24 and/or end panels 25. The containers 10, 20 are manufactured so that an average wall thickness at the bottom corner junctions 28 is greater than an average wall thickness of the side panels 24 and end panels 25. Further, these key structural areas 26, 28 can have a greater average wall thickness than that of the bottom panel 21. Still further, an average wall thickness of the bottom side corner sections 22 and/or bottom end corner sections 23 can have a greater average wall thickness than that of the side panels 24 and/or end panels 25. Also, the bottom side corner sections 22 and/or bottom end corner sections 23 can have a greater average wall thickness than that of the bottom panel 21.

Similarly, the lid 31 can be manufactured in a similar manner. Specifically, the top vertical corner sections 37 can have a greater average wall thickness than that of the top panel 32. The top vertical corner sections can have a greater average wall

thickness than that of the top side panels 35 and/or top end panels 36. Further, the top side corner sections 33 and/or top end corner sections 34 can have a greater average wall thickness than that of the top panel 32 and/or the top side panels 33 and/or the top end panels 36.

By utilizing the various guidelines set forth above, the overall weight of the containers 10, 20 can be reduced without adversely affecting the structural integrity thereof. Further, substantial material cost savings will result.

Turning to Fig. 5, a mold 50 is disclosed with cavities 51, 52 for manufacturing two separate containers. A die is shown schematically at 53. Turning to Fig. 6, a parison 54 is extruded through the die 53 through conventional means. However, the die 53 is a shaped die and an adjustable die as described below. The mold 50 has been opened during the extrusion of the parison 54. Turning to Fig. 7, the pinch plate 55 is closed on a bottom end 56 of the parison 54. As shown in Fig. 8, after extrusion of the parison 54 enclosure of the pinch plate 55, the mold 50 is closed and an injection pin or other means for inflating the parison 54 is inserted through the parison. As shown in Fig. 9, the parison is inflated against the mold cavities 51, 52 to provide two molded containers.

The containers preferably have an irregular or non-uniform wall thickness. This is achieved in two ways. First, by providing a shaped die 53 as illustrated in Figs. 10 and 10A. As shown in Figs. 10 and 10A, the die 53 includes an outer peripheral surface 61, an irregular inner peripheral surface 62 and an irregular annular gap 63 disposed therebetween. The outer peripheral surface 61 is an essentially circular or cylindrical surface. However, the surface of the inner peripheral surface 62 is non-cylindrical and therefore a parison extruded through the gap 63 has a thickness that is non-uniform radially or, in other words, a cross-section of the parison has a non-uniform thickness for varying the wall thickness radially around or partially across the wall surfaces of the resultant container 10, 20. Fig. 11 provides a graphical representation of various gap 63 thicknesses that can be provided with dies of structures similar to those shown in Figs. 10 and 10A. The die 53 of Figs. 10 and 10A, without adjusting the size of the outer peripheral surface 61 as discussed below, will provide a parison schematically illustrated at 65 in Fig. 12. Inflation of the parison will result in containers formed as shown in Fig. 3 with wall segments 66a-66g of varying thicknesses. Thus, the die 53 as shown in Figs. 10 and 10A can be

used to fabricate containers 10, 20 with vertical corner sections 26 that are thicker than end panels 25 and side panels 24.

To vary the thickness of the parison along an axially length of the parison, the outer surface 61 can be moved closer to or farther away from the inner surface 62 during extrusion of the parison through the gap 63. Preferably, the die includes a contractible and expandable structure 67 for this purpose. It will also be noted that the structure 68 which provides the inner peripheral surface 62 can also be expandable and contractible, the design of such a structure would be complicated due to the irregular surface 62. Thus, by expanding and contracting the outer surface 61, a parison 70 as shown in Fig. 15 can be provided with discreet segments 71a-71n of varying thicknesses which, when inflated will produce the containers shown in Fig. 16, also having a varying wall thickness along the length of the containers. Fig. 14 illustrates, graphically, how the die gap opening 63 can be varied during extrusion of a parison to vary the parison wall thickness as it is extruded through the die 53.

Finally, to vary the wall thickness of the parison, and consequently, the wall thickness of the parison after inflation, or the wall thickness of the resulting container, both radially, that is circumferentially around the container, and axially, that is, along the length or height of the container, an adjustable shaped die is utilized with an irregular inner surface 62 and expandable and contractible outer surface 61 which can produce a parison 75 as shown in Fig. 17. By utilizing both die shaping, *i.e.*, a shaped or irregular inner surface 62, along with parison programming, *i.e.*, varying the cross-sectional area of the die gap 63 during extrusion of the parison, the parison like the one shown at 75 in Fig. 17 can be extruded that has a varying wall thickness both radially, or cross-sectionally, and axially, or along a length of the parison 75. Thus, the parison 75 can be utilized to fabricate containers 10, 20 with thicker walls at key structural points, such as the vertical corner sections 26, bottom corner junctions 28 and handles 42 and thinner wall sections at the less important structural areas such as the side panels 24, end panels 25 and bottom panels 21. Similarly, lids can be fabricated using the extrusion blow molding processes disclosed herein with greater wall thicknesses at the top vertical corner sections 37, top corner junctions and reduced wall thicknesses at least important structural areas such as the top panel, top side panels and top end panels. Obviously, an infinite number of variations in wall thicknesses from discreet area to discreet area of each container 10, 20 and lid 31 can

be provided. All such variations are intended to fall within the spirit and scope of this disclosure.